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Role of Intraaortic Balloon Pump Counterpulsation in High Risk Coronary Rotational Atherectomy

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Objectives. This study sought to evaluate the role of intraaortic balloon pump counterpulsation in preventing hemodynamic instability and promoting a successful outcome during percutaneous transluminal coronary rotational atherectomy in high risk patients.

Background. The application of rotational atherectomy has widened to include patients with complex lesions and left ventricular dysfunction. Although intraaortic balloon pumping has been successfully used to provide hemodynamic support during balloon angioplasty, its role in high risk rotational atherectomy has not yet been defined.

Methods. In a retrospective review of 159 consecutive high risk patients who underwent rotational atherectomy, 28 had an intraaortic balloon pump placed electively before the procedure (Group 1) whereas 131 did not (Group 2).

Results. Group 1 was older and more likely to have multivessel disease and left ventricular dysfunction. Augmented diastolic pressure was maintained >90 mm Hg in all Group 1 patients, and significant procedure-related hypotension was encountered in nine Group 2 patients, requiring an emergency intraaortic balloon pump in five. Procedural success was achieved in all 28 patients in Group 1 and in 118 in Group 2 ($p = 0.07$). Slow flow occurred in 18% and 17% of Group 1 and 2 patients, respectively. Among patients with slow flow, non-Q wave myocardial infarction occurred only in Group 2 (0% vs. 27%). On multivariate analysis, elective intraaortic balloon pump placement was the only variable to correlate with a successful procedure uncomplicated by hypotension ($p < 0.05$). Hospital stay and vascular complications were similar in both groups.

Conclusions. Elective placement of an intraaortic balloon pump before coronary rotational atherectomy in selected high risk patients promotes both procedural hemodynamic stability and a successful outcome.

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Just as the initial application of percutaneous transluminal coronary angioplasty to low risk lesions widened to include those with high risk characteristics (1), so has the introduction of percutaneous transluminal coronary rotational atherectomy witnessed a parallel increase in the complexity of lesions and patients in which revascularization with this device is attempted (2,3). Although procedural success with the Heart Technology Rotablator (Heart Technology, Inc.) has been high and complications low (4), predictors of adverse outcome have emerged (3,4). In recent studies, modified American College of Cardiology/American Heart Association lesion score (5,6), increasingly diffuse disease, female gender, right coronary artery target lesion and stenosis angulation all correlated with major ischemic complications, including non-Q wave myocardial infarction (3,4).

Elective intraaortic balloon pump counterpulsation has been used successfully to provide circulatory support during balloon angioplasty in patients at high risk of procedure-related morbidity and mortality (7–9). The mechanisms of intraaortic balloon pump support during percutaneous revascularization include a reduction in cardiac afterload (10,11) and an increase in coronary blood flow after relief of coronary stenosis by balloon angioplasty (12). Although there is now broad experience with intraaortic balloon pump–supported angioplasty (7–9), to our knowledge its role during coronary rotational atherectomy among high risk patients has not been reported.

We performed a retrospective analysis of all rotational atherectomy procedures performed at our institution during a 1-year period. The current study compares baseline, procedural and outcome results of high risk patients who did and did not receive an elective intraaortic balloon pump before rotational atherectomy.

Methods

Patients. Between June 3, 1993 and June 3, 1994, 238 patients underwent coronary rotational atherectomy at the University of California San Diego Medical Center. To study the impact of elective placement of an intraaortic balloon pump before coronary rotational atherectomy among high risk

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candidates, we retrospectively reviewed the records and cineangiograms of all patients who underwent rotational atherectomy during this period. Lesions were evaluated and classified by the investigators using the modified American College of Cardiology/American Heart Association (ACC/AHA) lesion score (6), and coronary stenoses were measured using calipers. Seventy patients with type A or B1 lesions, and therefore at low risk, were excluded from our analysis. One patient who had presented with acute myocardial infarction <24 h before the procedure was also excluded. Angiograms were not available for review in three patients. In five patients, rotational atherectomy was attempted; however, the lesion could not be crossed with a guide wire, and the procedure was abandoned.

The remaining 159 patients formed the current study group. In 28 patients, an angiographically driven decision was made on the basis of left ventricular function, modified ACC/AHA lesion score and amount of myocardium at risk, to electively place an intraaortic balloon pump (Group 1) before coronary intervention. This procedure was performed for severe left ventricular dysfunction (ejection fraction ≤35%) in nine patients; for moderate left ventricular dysfunction (ejection fraction 36% to 40%) before left anterior descending atherectomy in two patients; and for a calcified, ostial, protected left main coronary artery in one patient. Because of concern about the amount of myocardium supplied by the target vessel, an intraaortic balloon pump was placed before 13 ostial or proximal left anterior descending coronary artery (multivessel disease in 11, calcification in 9) and 3 left circumflex coronary artery (multivessel disease in 2, ostial in 1) procedures. Each intraaortic balloon pump was placed through a sheath and provided one-to-one counterpulsation before coronary intervention. The remaining 131 patients (Group 2) with type B2 or C lesions did not receive an elective intraaortic balloon pump. Patients without femoral access for intraaortic balloon placement were not considered for rotational atherectomy.

Rotational atherectomy procedure. The technique of rotational atherectomy has been previously described (2). All patients were pretreated with 325 mg of aspirin before coronary intervention. An 8F sheath was placed in the femoral vein and a 9F sheath in the femoral artery using the modified Seldinger technique. A 6F bipolar temporary pacing catheter was placed in the right ventricle for prophylaxis of transient bradyarrhythmias for right, left circumflex and proximal left anterior descending coronary procedures.

In Group 1, a 9.5F intraaortic balloon pump (Datascope Corp.) was placed percutaneously through the femoral artery and counterpulsation initiated. The coronary artery was selectively engaged using a 9F or 10F high flow guiding catheter. Heparin (10,000 U) was administered as a bolus, and the activated clotting time was maintained at >300 s throughout the procedure, using additional boluses of 2,000 to 5,000 U as required.

The lesion was crossed with a 300-cm, 0.009-in. (0.023 cm) Type C wire (Heart Technology, Inc.) manipulated into the distal aspect of the artery. The Rotablator burr was then advanced over the wire to a position proximal to the target stenosis. The burr was then activated, and rotational atherectomy was performed by slow advancement of the burr into the lesion punctuated by slight, brief burr withdrawal simulating a slow "pecking" motion, with care taken to avoid a decrease in revolutions per minute >10%. The device was then withdrawn and, after intracoronary nitroglycerin administration (100 to 200 μg) and angiography to assess the progress of the procedure, it was exchanged for burrs of increasing size. After rotational atherectomy, complementary balloon angioplasty was performed at low pressure (2 atm).

The patient returned to the cardiac intensive care unit where an electrocardiogram (ECG) was obtained immediately and was repeated after 12 to 18 h. Depending on procedural outcome and hemodynamic stability, the intraaortic balloon pump was either removed later the same day or was continued overnight. In all cases, the intraaortic balloon pump and vascular sheaths were removed when the activated clotting time was <200 s. Arterial tamponade was achieved using either manual pressure or mechanical compression with the Compressar (Instromedix) or FemoStop (USCI) devices.

An intravenous heparin infusion was continued for 48 h, keeping partial thromboplastin times in the 70 to 90-s range. A creatine kinase (CK) assay was performed every 8 h for the first postprocedural 16 h in all patients and, among patients with abnormal values, until a peak had occurred. A CK, MB fraction (CK-MB) isoenzyme assay was performed for all elevated CK values. Intravenous nitroglycerin was replaced after 24 h with an oral or cutaneous preparation, and calcium antagonists were administered routinely unless contraindicated.

Definitions. The following definitions were used: 1) *Procedure-related hypotension.* For Group 1, augmented diastolic pressure <90 mm Hg; for Group 2, systolic pressure <90 mm Hg. 2) *Non-Q wave myocardial infarction.* Elevation of CK levels greater than twice the upper limit of normal, with CK-MB >5% and without the development of pathologic Q waves on the ECG. 3) *Ischemia on the ECG.* New ST segment elevation or depression or T wave changes on the immediate postprocedural ECG. 4) *Slow flow.* Occurrence of slow or absent distal flow (Thrombolysis in Myocardial Infarction [TIMI] trial flow grade ≤2) without obvious dissection, thrombus or spasm (13,14). 5) *Procedural success.* TIMI flow grade 3, <50% final diameter stenosis and no death, emergency coronary artery bypass surgery, coronary stenting or myocardial infarction. 6) *Combined outcome.* Procedural success without procedure-related hypotension.

Statistical analyses. Continuous variables are expressed as mean value ± SD. Unpaired Student t tests were used to compare continuous variables. Where distributions were not normal, nonparametric statistics, such as the Mann-Whitney U test were used. Chi-square analyses were used to test differences between groups on categoric variables. Multivariate analyses were performed using stepwise logistic regression analyses using complications and success as outcomes and individual preprocedural variables as independent variables.

Table 1. Clinical Characteristics of 159 Study Patients

	Group 1: IABP (n = 28)	Group 2: No IABP (n = 131)	p Value
Age (yr)	72 ± 7	66 ± 11	0.007
Female gender	7 (25)	30 (23)	NS
Previous MI	16 (57)	59 (45)	NS
CABG	8 (29)	29 (22)	NS
Current smoking	3 (11)	26 (20)	NS
Diabetes mellitus	6 (21)	45 (34)	NS
Hypertension	13 (46)	79 (60)	NS
Hypercholesterolemia	13 (46)	55 (42)	NS
Class III or IV angina	26 (93)	104 (79)	NS

Data presented are mean value ± SD or number (%) of patients. CABG = coronary artery bypass grafting; IABP = intraaortic balloon pump; MI = myocardial infarction.

Stepwise logistic regression was performed using Biomedical Data Processing (BMDP) logistic regression. A backward stepwise selection procedure was used to identify independent predictors of success and complications. Analyses were performed with and without the ACC/AHA classification because overlap exists between the score and the individual factors comprising the score. Statistical significance was accepted at $p < 0.05$.

Results

Clinical characteristics. Patients who received an elective intraaortic balloon pump were older than those who did not (Table 1). There were no other significant clinical differences.

Table 2. Angiographic Characteristics of 159 Study Patients

	Group 1: IABP (n = 28)	Group 2: No IABP (n = 131)	p Value
LVEF (%)	49 ± 20	60 ± 13	0.0002
≤35%	9 (32)	7 (5)	0.0001
MVD	26 (93)	88 (67)	0.0062
Target lesion			
LAD	18 (64)	69 (53)	NS
LCx	8 (29)	18 (14)	NS
LMCA	2 (7)	5 (4)	NS
RCA	0 (0)	39 (30)	0.001
Restenosis	5 (18)	38 (29)	NS
Type B2 lesion	24 (86)	110 (84)	NS
Type C lesion	4 (14)	21 (16)	NS
Ostial location	8 (29)	17 (13)	0.04
Calcification	16 (57)	58 (44)	NS
Lesion length (mm)	9 ± 6	12 ± 8	NS
Preprocedural stenosis (%)	69 ± 9	73 ± 10	NS
Reference artery diameter (mm)	3.0 ± 0.4	3.0 ± 0.4	NS

Data presented are mean value ± SD or number (%) of patients. IABP = intraaortic balloon pump; LAD = left anterior descending coronary artery; LCx = left circumflex coronary artery; LMCA = left main coronary artery; LVEF = left ventricular ejection fraction; MVD = multivessel disease; RCA = right coronary artery.

Table 3. Procedural Technique

	Group 1: IABP (n = 28)	Group 2: No IABP (n = 131)	p Value
Initial burr size (mm)	1.6 ± 0.2	1.6 ± 0.2	NS
Final burr size (mm)	2.0 ± 0.2	2.0 ± 0.3	NS
Burring duration (s)	147 ± 70	150 ± 75	NS

Data presented are mean value ± SD. IABP = intraaortic balloon pump.

Angiographic characteristics. Compared with Group 2, patients in Group 1 had poorer left ventricular function and a greater incidence of severe left ventricular dysfunction. Multivessel disease was more frequent in Group 1 (Table 2). Left anterior descending coronary lesions represented almost two-thirds of the targets in Group 1. No patient undergoing a right coronary artery procedure received an elective intraaortic balloon pump. The proportion of patients in modified ACC/AHA classes B2 and C was similar in both groups. An elective intraaortic balloon pump was more frequently placed when coronary lesions were ostial in location. Lesion length did not differ between groups.

Procedural technique. Initial and final burr sizes, number of burrs used and total burring duration were not different between groups (Table 3). Two patients (7%) in Group 1 underwent a second interventional procedure immediately after the rotational atherectomy (diagonal angioplasty in one, obtuse marginal angioplasty in one). In Group 2, nine patients (7%) had a second intervention (diagonal angioplasty in four, obtuse marginal angioplasty in two, right coronary angioplasty in one, saphenous vein graft angioplasty in one, saphenous vein graft stent in one).

Procedural Success and Complications. Coronary rotational atherectomy was successfully performed in all 28 patients in Group 1 (Table 4). There were 13 unsuccessful procedures in Group 2. Five patients had TIMI flow grade ≤2 at the conclusion of the procedure. Non-Q wave myocardial infarction occurred in four of these five patients (80%), and

Table 4. Procedural Outcome and Complications

	Group 1: IABP (n = 28)	Group 2: No IABP (n = 131)	p Value
Procedural success	100 (81, 100)	90 (85, 95)	0.07
Emergency CABG	0 (0, 0)	1 (0, 1)	NS
Death	0 (0, 0)	2 (0, 4)	NS
Non-Q wave MI	0 (0, 0)	7 (0, 14)	NS
Combined outcome	0 (0, 0)	13 (10, 16)	0.04
Slow flow	18 (4, 22)	17 (11, 23)	NS
Dissection	18 (4, 22)	19 (12, 26)	NS
ECG ischemia	7 (0, 16)	13 (7, 19)	NS
Total CK (IU/liter)	90 ± 58	96 ± 73* 588 ± 218†	0.0001

*Absence of non-Q wave myocardial infarction (MI) (n = 122). †Presence of non-Q wave myocardial infarction (n = 9). Data presented are mean ± SD or percent of patients (95% confidence limits). CK = creatine kinase; ECG = electrocardiographic; other abbreviations as in Table 1.

Table 5. Rates of Non-Q Wave Myocardial Infarction Among Patients Who Developed Slow Flow

	Slow Flow (no. of pts)	Non-Q Wave MI [no. (%) of pts]
IABP (Group 1)	5	0 (0%)
No IABP (Group 2)	22	6 (27%)

pts = patients; other abbreviations as in Table 1.

one developed refractory ventricular fibrillation 14 h after the procedure and died. An additional five patients sustained a non-Q wave myocardial infarction. One patient had an extensive flow-limiting dissection with TIMI flow grade 1, requiring three 3.0-mm Wiktor stents with restoration of TIMI flow grade 3 and minimal residual stenosis. In one patient, with a chronic total occlusion at the ostium of the right coronary artery followed by a long diffusely diseased segment, the final residual stenosis was >50%. After atherectomy with a 1.75-mm burr in the mid-left anterior descending coronary artery, one patient developed chest pain, supraventricular arrhythmia and hypotension. An intraaortic balloon pump was immediately placed, and fluid and inotropic support led to transient stabilization. However, on transfer to the cardiac intensive care unit, severe limb ischemia due to the intraaortic balloon pump mandated its removal. The patient rapidly became hemodynamically unstable and was taken to the operating room for emergency bypass surgery. Despite successful grafting of the left anterior descending coronary artery, the patient could not be weaned from bypass because of severe ischemic left ventricular dysfunction and died in the operating room.

Procedure-related hypotension. Although systolic pressure decreased to <90 mm Hg in three patients (11%) in Group 1, diastolic pressure, augmented by an electively placed intraaortic balloon pump, was maintained at >90 mm Hg at all times. Hypotension occurred in nine patients (7%) in Group 2, requiring emergency placement of an intraaortic balloon pump for persistent hypotension and hemodynamic instability in five.

Arrhythmia. Transient atrial fibrillation developed in three patients (2%) in Group 2, resolving in all patients within 6 to 12 h of the procedure. Two patients developed ventricular fibrillation after transfer to the cardiac intensive care unit. In one patient it occurred within 30 min, and the patient responded to resuscitation. In the second patient, ventricular fibrillation occurred 14 h after the procedure and was refractory to all measures, and the patient died.

Impact of intraaortic balloon pump on non-Q wave myocardial infarction after slow flow. Although slow flow occurred with equal frequency in both groups, no patient in Group 1 who developed slow flow went on to sustain a non-Q wave myocardial infarction (Table 5). In contrast, 6 (27%) of 22 Group 2 patients who had slow flow developed a non-Q wave myocardial infarction within 24 h of rotational atherectomy; in 3 of 6, non-Q wave myocardial infarction occurred despite emergency placement of an intraaortic balloon pump.

One patient from Group 1 with multivessel coronary disease developed chest pain 48 h after successful left anterior descending rotational atherectomy. Coronary angiography revealed a patent left anterior descending coronary artery and a diffusely diseased right coronary artery with reduced flow, and the patient went on to sustain a non-Q wave myocardial infarction. Q wave myocardial infarction did not occur in either group.

Table 6. Logistic Regression Analysis of Combined Outcome

Variable	Coeff	SE	p Value
Prophylactic IABP	8.311	2.36	0.0454
Gender	1.9023	0.59	0.1411
Age	4.0054	1.56	0.0986
Previous MI	0.2920	0.58	0.6590
Angina class	0.6124	0.46	0.3350
Diabetes	−0.5085	0.58	0.3184
LVEF	0.1878	0.58	0.6647
1- vs. 2- and 3-vessel disease	0.3735	0.56	0.7256
Vessel treated	0.2565	0.67	0.5705
Lesion length	0.0184	0.80	0.8922
New lesion vs. restenosis	0.6124	0.70	0.4098
Ostial lesion	0.8446	1.10	0.2727
Bend lesion	0.2527	0.67	0.7241
Calcification	−0.9006	0.58	0.1393

Coeff = coefficient; other abbreviations as in Tables 1 and 2.

Dissection, perforation and ECG changes. Dissection was seen with similar frequency in both groups but was flow limiting in only one Group 2 patient (Table 4). Coronary perforation manifested by extravasation of contrast medium with persistent staining was present in three patients (2%) in Group 2. Electrocardiographic evidence of ischemia was present in 7% and 13% of Group 1 and 2 patients, respectively.

Assessment of impact of intraaortic balloon pump. To evaluate the role of elective placement of an intraaortic balloon pump in high risk patients, we used our definitions to calculate an end point combining procedure-related hypotension and an unsuccessful procedure (Tables 4 and 6). Patients in Group 1 had a significantly better combined outcome than those in Group 2 (0 [0%] vs. 17 [13%], respectively $p = 0.04$). By multivariate logistic regression, the only variable found to be predictive of a successful procedure without procedure-related hypotension was the prophylactic placement of an intraaortic balloon pump ($p < 0.05$).

Hemorrhagic and vascular complications. *Group 1.* One patient developed a pseudoaneurysm that was surgically repaired. A second patient experienced a groin hemorrhage and required a blood transfusion. A third patient developed a large arm hematoma after brachial cutdown and required a transfusion. However, there was no bleeding at the intraaortic balloon pump access site in the groin.

Group 2. One patient developed a large groin hematoma that required surgical repair and blood transfusion. One patient, described earlier, had acute limb ischemia forcing immediate intraaortic balloon pump removal.

Duration of hospital stay. Mean hospital stay was 2.6 ± 1.3 days for Group 1 and 2.4 ± 1.1 days for Group 2 ($p = 0.40$).

Discussion

The current study reports our experience with elective intraaortic balloon pump counterpulsation during high risk coronary rotational atherectomy. Although intraaortic balloon pump–supported rotational atherectomy has been described in a small number of high risk patients (2) the outcome of this strategy has not specifically been reported. We demonstrated that this strategy can facilitate a successful and uncomplicated procedural outcome in high risk patients undergoing rotational atherectomy.

High risk patient characteristics and selection for intraaortic balloon pump. Recent compelling data from Ellis et al. (4) and Warth et al. (15) have shown a correlation between modified ACC/AHA lesion criteria and major ischemic complications during rotational atherectomy, occurring with a frequency of 4.1%, 5%, 8.4% and 26.1% in type A, B1, B2 and C lesions, respectively. In the present study, patients who received a prophylactic intraaortic balloon pump were compared with those at higher risk for percutaneous revascularization on the basis of modified ACC/AHA lesion criteria. The "higher-risk" group was arbitrarily defined as patients with type B2 or C lesions and included some patients with left ventricular dysfunction. Patients with type A and B1 lesions undergoing rotational atherectomy have success and complication rates unlikely to be favorably influenced by elective intraaortic balloon pump placement (4); these patients were not included in the current report. The group receiving an elective intraaortic balloon pump was older, had more severe left ventricular dysfunction and was more likely to have multivessel disease and an ostial lesion than did the comparison group. No patient with a right coronary stenosis was treated with a prophylactic intraaortic balloon pump.

The decision to electively place an intraaortic balloon pump was individualized and based on the patient's angiographic profile. The chief indications were significant left ventricular dysfunction and ostial or proximal stenosis, often with severe calcification and multivessel disease, in the left anterior descending or, less frequently, the left circumflex coronary artery. In the latter patients, there was clinical concern that significant distal embolization of atherectomized particles could result in hemodynamic instability.

Procedural success. Previous studies (2,4) have reported overall success rates for rotational atherectomy of 90% to 94%. However, neither of these studies specifically report procedural results for the minority of patients who received a prophylactic intraaortic balloon pump. In the present study, procedural success was achieved in 100% of patients with and in only 90% of those without an elective intraaortic balloon pump. However, when the five patients in whom the lesion could not be crossed with a guide wire are included, the procedural success rate for both groups combined was slightly lower than previous reports at 89%. This somewhat lower rate may reflect the complexity of lesions in the patients in the current study. In no patient with an elective intraaortic balloon pump were we unable to cross the lesion with a guide wire.

Procedure-related hypotension and combined outcome. The occurrence of procedure-related systolic hypotension was equal in both groups. Systolic pressure decreased to <90 mm Hg in three (11%) and nine (7%) patients in Groups 1 and 2, respectively and necessitated emergency intraaortic balloon pump placement in five Group 2 patients. In no patient who received an elective intraaortic balloon pump was diastolic pressure allowed to decrease <90 mm Hg, thus maintaining coronary perfusion. Multivariate analysis of the combined end point demonstrated that in light of all the preprocedural patient risk factors and lesion characteristics, placement of an intraaortic balloon pump prophylactically was the single most important factor associated with a more favorable procedural outcome.

Slow flow and effect of intraaortic balloon pump on incidence of non-Q wave myocardial infarction after slow flow. In the current study we observed slow flow in the target artery with equal frequency in both groups. Published reports (4) have documented slow flow during rotational atherectomy in 9% of procedures. In our patients, slow flow occurred with almost twice the frequency of that observed by Ellis et al. (4). This difference may be due in part to the inclusion in the latter study of patients with type A and B1 lesions, which have a lower risk of a complicated outcome.

In the study by Ellis et al. (4), slow flow was associated with non-Q wave myocardial infarction in fully 25.9% of patients and with Q wave myocardial infarction in a further 7%. Among patients in the current study who did not have an elective intraaortic balloon pump, slow flow was followed by non-Q wave myocardial infarction in 27%. Despite a similar incidence of slow flow, no patient with an elective intraaortic balloon pump developed a non-Q wave myocardial infarction. During rotational atherectomy, the release of microparticulate debris and microcavitation within the epicardial coronary artery may contribute to slow flow (16,17). Recent studies have shown that intraaortic balloon pumping enhances coronary flow (18) and that a significant increase in coronary flow follows relief of obstructive stenosis by angioplasty, which is further augmented by intraaortic balloon pump counterpulsation (12). Thus, intraaortic balloon pumping appears to be effective in promoting diastolic perfusion and increasing coronary flow, thereby preventing the myocardial damage that accompanies slow flow. The salutary effect of intraaortic balloon pump counterpulsation has also recently been shown (19) to promote patency of the infarct-related artery and to reduce recurrent ischemia rates after primary angioplasty for myocardial infarction.

Vascular complications. Peripheral vascular complications and bleeding related to the intraaortic balloon pump have remained a major concern in trials evaluating supported percutaneous revascularization. In one report (7), 3 (11%) of 28 patients developed balloon pump-related complications requiring surgical intervention. A recent study (19) reported a similar blood transfusion requirement among intraaortic balloon pump recipients with no increase in vascular complications needing surgical repair. In the present study, neither transfusion requirement nor vascular complications were significantly higher among intraaortic balloon pump recipients than nonrecipients. These data suggest that the benefit of intraaortic balloon pump support among high risk rotational atherectomy candidates may be achievable without an increase in adverse outcome or prolongation of hospital stay.

Study limitations. Although these data are provocative and encouraging, several limitations must be acknowledged. This study suffers from all weaknesses inherent in retrospective data and, although the reduction in incidence of non-Q wave myocardial infarction after slow flow among elective intraaortic balloon pump recipients is intriguing, the data remain largely observational. The small number of patients in both groups and of study outcomes also limit our data. The difficulty with defining procedure-related hypotension in two groups of patients with markedly different systemic pressures clearly weakens our ability to reach firm conclusions with regard to this variable. Further large randomized trials will be needed to confirm or refute our preliminary data.

Conclusions. Prophylactic use of intraaortic balloon pump counterpulsation among high risk patients undergoing coronary rotational atherectomy contributes to an uncomplicated and successful outcome. If patients are carefully selected for intraaortic balloon pump support on the basis of angiographic characteristics, the outcome for a high risk group is as good as, and perhaps better than, that of a lower risk group. That this benefit can be achieved without an increase in duration of hospital stay or balloon pump-related complications suggests a new role for this familiar technology.

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